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CONTINUOUS CASTING DEVICE FOR GRID OF LEAD BATTERY

CLAIM(S)

1. A continuous casting device for grid bodies for a lead battery wherein a pair of molds out of multiple rectangular shaped molds, in the surfaces of which are carved the grid shape, are connected in an annular shape with a hinge mechanism, and are positioned to circulate synchronously between a pair of sprockets, 5, 5' and 6, 6', and wherein the back surfaces of said multiple rectangular shaped molds opposing to each other in the linear sections between the aforementioned sprockets are constantly pressed to form a pair of matching molds; said continuous casting device being characterized in that said annular mold is inclined downward in the advancing direction of the matching molds, and in that a projection is provided to a horizontal groove connecting the adjacent rectangular molds.

DETAILED DESCRIPTION OF THE INVENTION

(0001)

(Field of Industrial Application)

The present invention pertains to a continuous casting device for the grid for use in a lead battery.

(0002)

(Prior Art)

The grids for a lead battery are generally manufactured by a gravity casting method or a mechanical processing method. With the gravity casting method, a melt is injected into a pair of molds in which the shape of grid called a book mold is carved, and the grid shaped like that shown in Fig. 8 (A) is manufactured one by one. With method, however, a production efficiency is poor since a batch method is used for manufacturing the grids. In addition, there is a problem that the process cannot continuously be linked to the process of charging a paste, which is an after-process.

(0003)

Therefore, in recent years, as a method for manufacturing a grid that replaces the prior art gravity casting method, a mechanical processing method has come to be used. As a representative one of this mechanical processing method, there is the grid manufacturing method using an expanding system. The grid manufactured by this method has a shape shown

in Fig. 8 (B) and is continuously linked to the after process, so the productivity of plates was remarkably improved but, on the other hand, the following problems arise.

(0004)

To manufacture the expanded grid, a matrix metal of lead alloy needs to be shaped into a sheet form by a rolling method. Subsequently, this lead alloy sheet is processed into an expanded grid by the expansion machine but, since a very large-scale device is necessary for manufacturing the lead alloy sheet and expanding it. In addition, the grid that can be manufactured by this method uses only a lead-calcium alloy and it is difficult to use the method for lead-antimony alloy which is generally and widely used for lead batteries. Moreover, as can be easily assumed from the grid shape shown in Fig. 8 (B), there is a critical problem that the grid is very susceptible for expanding. In the case when the expanding grid is used for an anode plate, the anode plate contacts with the cathode strap by the significant expansion of the grid caused by charging and discharging of battery, which results in a short circuit and in a short useful like of the battery. There also was a problem that the grid had a high electrical resistance and a poor voltage characteristic of the battery.

(0005)

Accordingly, the casting method that was proposed to solve the aforementioned problems is a continuous grid manufacturing method. Many proposals have been made regarding this method in the past. For example, the U.S. Patent 4, 349, 067 discloses that a melt feeding section called a shoe is brought into contact with a rotating drum in which the grid form is carved, and the cavity of mold formed between the drum and the shoe is filled with a melt to cast the grids continuously. The conventional proposals basically all follow the aforementioned system but still come with a few problems.

(0006)

More specifically, the grid cast by this system has the sectional shape shown in Fig. 7 since the grid shape is carved only in the outer circumference of the drum. Therefore, as can be easily assumed from this shape, the filled paste tends to fall off more than in the case of grid manufacturing by the prior art gravity casting method that uses a pair of molds having the sectional shape shown in Fig. 6.

(0007)

The shoe which is a feeding section of a melt is secured, so the drum rotates while sliding on the shoe, generating multiple blow holes on the shoe surface of the manufactured grid. In case when it is used for the anode plate

in particular, corrosion of grid is significant, so the battery with a long useful life cannot be produced, which is a problem.

(0008)

In addition, with the aforementioned continuous casting method, cooling of the melt fed into the mold is difficult, so the grid of lead alloy, such as a Pb-Ca group alloy or a Pb-Sb group alloy, having a relatively narrow solidification range can only be manufactured, and a very thick grid could not be manufactured, which is also a problem.

(0009)

(Problems of the Prior Art to Be Addressed)

As mentioned above, with the prior art manufacturing method for a grid of a lead battery, an efficiency in production was poor and the grid characteristics were poor even if the production efficiency was good. The present invention attempts to solve the problems with the prior art by presenting a method to continuously manufacture the grid with excellent characteristics with the production efficiency.

(0010)

(Means to Solve the Problems)

In the method of the present invention, of multiple rectangular shaped molds in the surface of which the grid shape is carved, a pair of molds connected in an annular shape with a hinge mechanism are positioned to circulate synchronously between a pair of sprockets; the back surfaces of multiple rectangular shaped molds opposing to each other in the linear section between the aforementioned sprockets are constantly pressed to form a pair of matching molds; the annular mold is inclined so that the advancing direction of the matching molds become lower; a projection is provided to the groove in the horizontal direction that connects the adjacent rectangular shaped molds; a melt is continuously fed into this mold; thus the grids having the characteristics that can be cast by the matching molds of the aforementioned prior art batch system can be continuously manufactured.

(0011)

(Embodiment Examples)

Fig. 1 shows a planar view of the continuous casting device body for the grid of lead battery as well as its sectional view of the D-D section. In the figure, 1 indicates the rectangular shaped mold, and on its one planar surface, the shape of grid is carved. To its back surface, is attached a segment 2 of a chain for connecting the rectangular molds with a hinge

mechanism. By this, are connected multiple rectangular molds to constitute the annular mold A. In the figure, 3 and 4 are also the segments of the chain sharing the same structure, respectively, and they constitute the annular mold B which is a counter part for forming the pair together with the annular mold A. The pair of annular molds A and B circulate synchronously between the sprockets 5, 5’ and 6, 6’.

(0012)

On the linear section 7 between the aforementioned pair of sprockets, the annular molds A and B are pressed against each other to form the mold, and, at the same time, the annular mold, as shown by the sectional view of D – D, is always inclined by θ degree relative to the horizontal surface so the advancing direction of the molds becomes lower.

(0013)

The rectangular shaped mold indicated by the sectional view of C-C in Fig. 1 is explained more in detail with reference to Fig. 2. In the figure, 1 and 3 indicate the rectangular molds, respectively, and 8 and 9 indicate the cavities carved into the grid shape, respectively. At the top end of the surface where the grid for the rectangular shaped molds 1 and 2 are carved, diagonally cut out sections 10 and 11 are provided, respectively, and a V-shaped groove is made by pressing the pair of rectangular molds against

each other; each of 12 and 13 indicates a pin hole for securing the matched mold formed by the rectangular molds 1 and 3 from being displaced.

(0014)

On the right and left sides on the back surfaces of mold 1 and mold 3, pulleys, 14, 14' and 15, 15' attached to a コ-shaped cavity are provided. The mold 1 smoothly moves on the V-shaped rail 16' on the fixed plate 16 and the mold 3 moves on the V-shaped rail 19' of movable plate 19 attached to the fixed plate 18 via the air cylinder 17 for pushing the mold 3.

(0015)

In the same figure, 2, 2' and 4, 4' indicate the segments of the chain attached to the top and the bottom of rectangular molds 1 and 3, respectively. By these segments, multiple rectangular molds are connected. In the figure, 20 indicates a device for heating the mold. The feeding port of the melt is provided somewhere along the linear section 7 of the mold in Fig. 1. The position of the melt feeding port 12 needs to be carefully selected since there is a danger of the melt's flowing out before the pair of rectangular molds is formed into a matched mold.

(0016)

The reason for inclining the annular mold relative to the horizontal surface, as mentioned above, is to prevent the melt from leaking out when the melt reversely flows from the gap between the rectangular molds immediately before forming the matched mold. By thus inclining the annular mold, the melt port can be provided to somewhat rear section, by which the device itself can be put into a compact size.

(0017)

Fig. 3 (A) shows an anterior view of the grid carved in the planar surface of the rectangular mold 1, and Fig. 3 (B) shows a profile of the E-E section in Fig. 3 (A). In the figures, 22 indicates section corresponding to the upper parent frame in the horizontal direction of grid body, 21 the section in the upper section of mold that corresponds to the lower parent frame, and 23 the section corresponding to the child frame in the horizontal direction other than 21 and 22. In the connecting groove 25 connecting the adjacent molds, is provided a projection 26 that has a diameter half the with of groove and height 2/3 depth of groove. Fig. 3 (B) indicates the sectional view of the E – E section of groove 25. A taper shape is provided to the projection for better releasing.

(0018)

Subsequently, the embodiment example of casting the lead-antimony group continuous grids by using the continuous casting device is explained below. First, the air cylinder 17 is activated; then, the annular mold in the linear sections 7 of the annular molds A and B are pressed against each other to make the matched mold; subsequently, the driving device (omitted from the figures) connected to the sprocket 5 is activated; the chain is moved by meshing in the teeth of sprocket and, at the same time, the rectangular mold connected to the chain is moved in the direction indicated by the arrow in Fig. 1.

(0019)

Then, the heating device 20 provided to the back surface of the matching mold is activated, the releasing agent is coated to the surface of the mold when the mold temperature reached about 150℃. At this time, the temperature of the mold drops, so when the temperature rises again and reaches 160 – 170℃, the melt that has reached approximately 450 – 480℃ is injected from the feeding nozzle into the V-shaped groove of the matching mold.

(0020)

The melt is filled into the groove carved into the grid shape of each matching mold. The melt flow condition at this time is explained with reference to Fig. 3. The melt injected into the V-shaped groove fills the carved section 21 in belt shape on the upper section of the mold, subsequently passes through the section 24 corresponding to the frame in the vertical direction, gradually is spread in the groove 23 in the horizontal direction, and is filled in the entire mold.

(0021)

The adjacent matched molds are connected only by the connection groove 25. Since the projection 26 is provided to the connection groove 25, when the melt flows out to the adjacent molds, the grid frame is not cut off by the resistance of projection that efficiently pushes the melt. If the projection is not provided in the connection groove 25 between the adjacent molds, since the annular old is inclined, as shown in Fig. 1, the melt that has flown into one mold does not stay in the mold but directly flows out to the small frame in the horizontal direction and flows down to the lower direction. So the pushing of the melt does not work, breaking the grid frame and making it difficult to manufacture excellent continuous grids. The continuous grids cast by the present invention are like that shown in Fig. 4. The continuous grids thus cast are, after having been processed into the

shape shown in Fig. 5, filled with lead battery paste, and subsequently cut off one by one to be made into an electrode plate.

(0022)

In addition, as explained above, in the present invention, the annular mold is inclined to be lower in the advancing direction. This is to prevent the melt injected in the mold from reversely flowing and leaking from the gap between the molds, and it was found from the experiments that the inclination angle θ is preferably about 5^0 or higher.

(0023)

The sectional shape of the grid body cast by the continuous casting device of the present invention is similar to the one that has been gravity cast by the prior art book mold shown in Fig. 6. Since one of the surfaces is not planar like the grid body manufactured by the prior art continuous casting machine of Fig. 7, the paste can be charged well, so not only the electrode plate excellent in anti-vibration is produced but also the blow holes are not generated due to the absence of sliding section and the grid body excellent in anti-corrosion was continuously manufactured. Also, the continuous grid bodies did not have blow holes and were excellent in anti-corrosion.

(0024)

(Advantage of the Invention)

By the continuous casting device for the grid of the lead battery of the present invention, the following advantages can be produced.

a) The grids can be manufactured continuously and efficiently and the manufacturing can be continued smoothly to the after-process, by which the electrode plate manufacturing steps can be dramatically streamlined by automation.

b) The type of usable alloy needs not be a specific type, but the lead-calcium group of lead-antimony group can be used for casting, and the thickness of the grid body can be thin or thick in manufacturing a variety of grid bodies.

c) In the present invention, the grid bodies are manufactured continuously; since the grid having the same shape as that made by the prior art gravity casting method can be manufactured, the anode grid having excellent characteristic without the blow holes and with excellent anticorrosion are demonstrated.

d) The sectional surface shape of the grid manufactured by the continuous casting device of the present invention is the same as the grid manufactured by the prior art gravity casting method, and both surfaces of the electrode plate filled with the past are sufficiently covered with the paste, demonstrating excellent filling. In addition, falling off of the active substance hardly occurs and anti-vibration is also excellent.

BRIEF DESCRIPTION OF THE DRAWINGS

Fig. 1 shows a planar view of the continuous casting device of the lead battery grid and a sectional view of the D-D section in the present invention.

Fig. 2 shows a sectional view of the C – C section of Fig. 1.

Fig. 3 shows an anterior view of the rectangular casting mold.

Fig. 4 shows a block diagram of the continuous grids manufactured by the continuous casting device of the present invention.

Fig. 5 shows a block diagram of the grid processed into the continuous grids by the continuous casting device of the present invention.

Fig. 6 shows a sectional view of the frame of the grid manufactured by the prior art gravity casting method.

Fig. 7 shows a sectional view of the frame of the continuous grids manufactured by the continuous device for the prior art lead battery grid.

Fig. 8 (A) shows a block diagram the grid manufactured by the prior art gravity casting method. Fig. 8 (B) shows a block diagram of the grid manufactured by the prior art expanding method.

1, 3. rectangular mold

2, 2', 4, 4'. segments of the chain

5, 5', 6, 6'. Sprocket

14, 14’, 15, 15’. Pulley

16, 16’, 19, 19’. V-shaped rail

21. carved section on the upper section of the mold

22. upper parent frame section in the horizontal direction

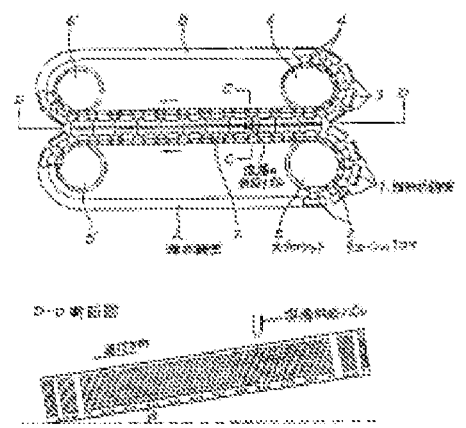
23. child frame section in the horizontal direction

24. frame section in the vertical direction

25. connection groove between the adjacent molds

26. projection

【図1】



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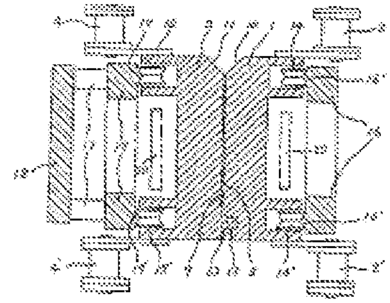

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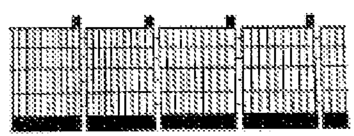
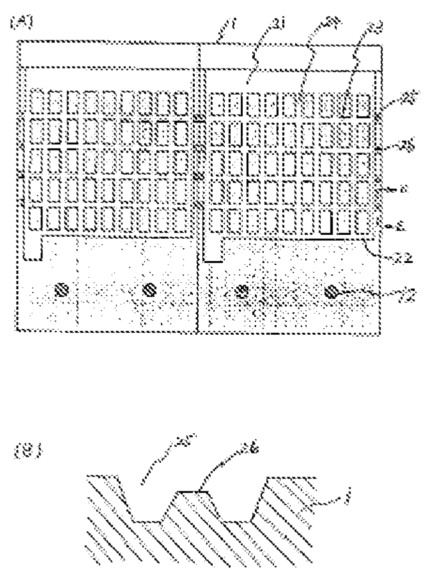


【図6】

【図7】

【図3】



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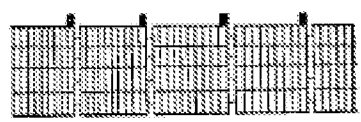

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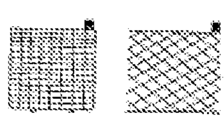

(A)　(B)

Translations
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Akiko Smith